

Diabetic Foot in Primary and Tertiary (DEFINITE) Care

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Mission Statement

DEFINITE Care is an inter-institutional and multi-disciplinary team (MDT) health systems innovation within NHG. It aims to achieve coordinated MDT care across primary and tertiary care for patients with Diabetic Foot Ulcer (DFU). The 4 workplans of DEFINITE Care are to (1) scale up existing primary care DM Foot Screening and Surveillance, Treatment, Escalation Programme for ulcer prevention (DM Foot STEP) and tertiary care MDT-style Lower Extremity Amputation Prevention Program (LEAPP) clinics, (2) closed-loop coordination of care between primary and tertiary institutions, (3) adoption of a patient-centric and patient-owned digital wound imaging app and (4) health economics analysis to evaluate cost effectiveness and long-term financial sustainability of the programme

Core Team Members					
	Name	Designation	Department		
Program Director	Dr. Joseph Lo	Consultant	Surgery, WH		
Institution Leads	Dr. Elaine Tan	Associate Consultant	NHGP (Toa Payoh)		
	Dr. Liew Huiling	Consultant	Endocrinology, TTSH		
	Dr. Desmond Ooi	Senior Consultant	General Surgery, KTPH		
	Dr. Hoi Wai Han	Senior Consultant	Medicine, WH		
Program Evaluation	Dr Gary Ang (Consultant), HSOR				
Podiatrists	Chelsea Law (KTPH), Pauline Ang (NHGP), Tiffany Chew (TTSH)				
Program Manger	Ms. Rose Low		Group Integrated Care		
DM Foot Coordinators	Ms Koo Hui Yan, Mr Low Kai Qiang	1s Julia Choo,			

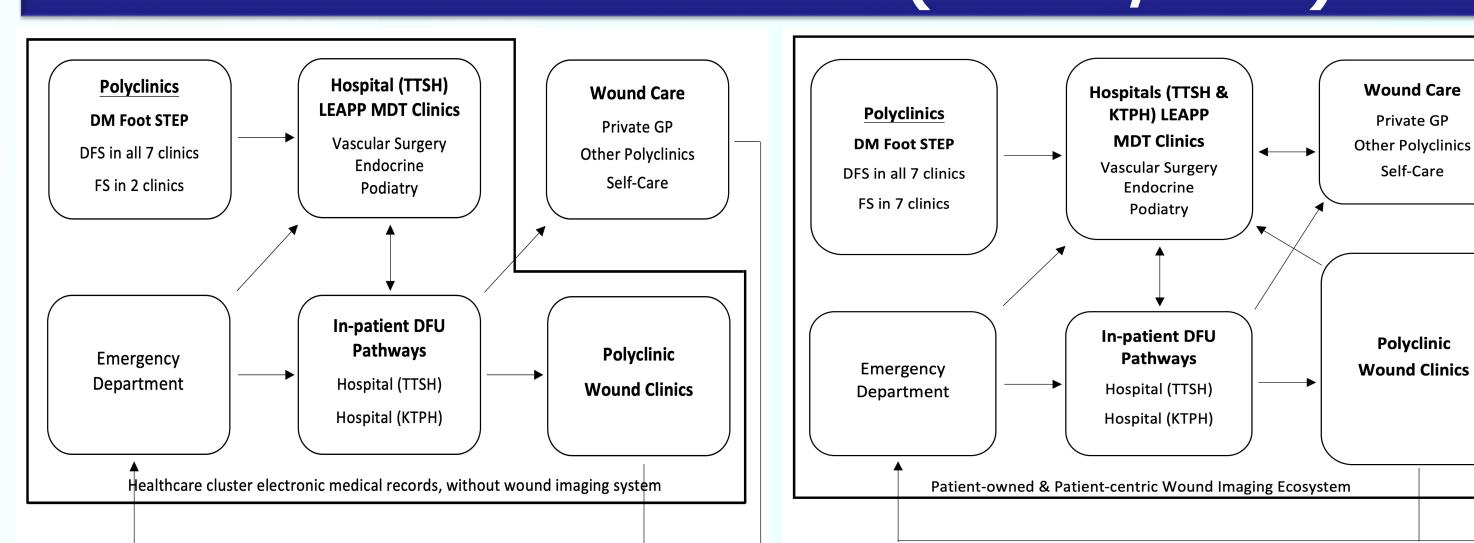
Evidence for a Problem Worth Solving

- 1 in 3 patients with diabetes are at risk of developing DFU [1] and Singapore has three times the OECD average of DM-related lower extremity amputations (LEA) [2]
- In Singapore, there is an estimated \sim 1,500 DM-related LEA each year (average of 4 per day) [3]
- This is associated with a heavy economic burden of disease, with estimated gross healthcare cost per patient for hospital care (inpatient and specialist outpatient) and primary care at USD \$16,920 in 2017 [4]. For patients who present with DFU-only, eventual minor LEA and major LEA, their mean cost per patient-year was USD \$3368, \$10,468 and \$30,131 respectively [5]

Current Performance of a Process

- Retrospective data from 2013-2017 showed a high clinical and economic burden of DFU, with incidence of minor amputation at 36.4% and major amputation at 6.5% [5]
- Within NHG, the Diabetic Foot Workgroup convened in 2017 identified health services deficiencies for DFU care, which included variability in diabetic foot screening (DFS) rates across different primary care polyclinics, lack of uniformity in provision of the rapid access MDT LEAPP clinic services for patients referred from primary care to tertiary care, high patient default rates, lack of a wound imaging system within our electronic medical records system and lack of coordination across primary and tertiary care with respect to comanaged patients post diabetic limb salvage procedures from the hospitals

Flow Chart of Process (Before/After)



Programme Logic Model PROCESSES MEDIUM TERM LONG TERM ↑ screening of high-risk patients ↓ DFU related 个 patients 个 DFU risk 个 risk factors ↓ incidence amputations 个 patients factors remediated 个 DFU health educated on DM through DM detected **↓** DFU literacy self-care Foot STEP ▶个 DFU health 个 scale of literacy current DM 个 DFU early 个DFU early 个 DFU 个 ulcer-free 个 patients w/ foot initiatives healing follow-up: NHGP - Funding 个 patients 个 DM care 个 DM control / podiatrist - Manpowei managed at LEAPP MDT - MDT clinics 个 DFU early 个 DFU MDT ↓ DFU - Collaboration clinics escalation and ↑ patients seen - Care severity ↓ major LEAs expedited tertiary coordination progression 🔽 个 tertiarv at integrated MDT care ↓ minor LEAs hospitals - Wound care clinic (osteomyelitis care slots 个 DFU care gangrene, abscess) igert appointment waiting time 个 primary / Standard tertiary diabetic **↓** DFU \downarrow unplanned workflow & foot care economic improved coordination burden in multiple visits system of (right siting of referral across care)

Implementation Ecosystem **LEAPP** Clinic NHGP DM Foot **STEP DEFINITE Care** Screening & Surveillance, Diabetic Foot in Fast track Referra Treatment, Escalation Extremity Amputation Programme for ulcer Primary and Tertiary Prevention revention Programme Diabetic Foot At Risk Foot **Active Foot Disease** Eco **Low Risk High Risk Moderate Risk Foot in Remission** Diabetes foot screening **Fast track Escalation Foot Protection Primary Care Foot Surveillance Team** LEAPP Polyclinics/ GPs **Tertiary Care Podiatry** Inpatient foot Care Preventive care/ Raise awarenes Foot surveillance and protection Optimal glycaemia control Multi-disciplinary foot care approach Targeted management of foot risk factors Preventive basic foot care Timely foot wound assessment and treatment Personalized foot care education Proper footwear choices Rapid revascularization Pre-emptive treatment of pre-ulcerative state Early escalation of foot problems Appropriate antibiotic regime for infection Foot attack advice, Actively seek medical help Therapeutic offloading footwear devices Timely referral to hospital <u>ص</u> Optimization of CV risk factors Admission for high septic burden HG Shared wound care Prevent Amputation, Limb salvage Diabetic Foot Maintaining foot in remission Coordinators Patients and Healthcare Professionals Engagement, Education and Empowerment

Results

Between June 2020 and December 2021, there were 3,475 unique patients with DFU with mean age at 65.9 (SD 12.9) years, 61.2% male, mean baseline HbA1c at 8.3% (SD 2.1) with mean diabetes duration at 13.3 (SD 8.8) years, mean diabetes complication severity index (DCSI) at 5.6 (SD 2.7) and mean Charlson Comorbidity Index (CCI) at 6.8 (SD 3.1).

Outcomes	DEFINITE Care	Retrospective	p value			
	(Jun 2020-Dec 2021)	(2013-2017)				
	(n=3,475)	(n=1,729)				
Minor LEA, n (%)	302 (8.7)	630 (36.4)	0.0001			
Major LEA, n (%)	176 (5.1)	113 (6.5)	0.0338			
1-year mortality, n (%)	255 (9.1)	107 (6.2)	0.1326			
Cardiovascular Profile	Pre-DEFINITE	Post-DEFINITE	p value			
(95% CI)	Care	Care				
Mean HbA1c, % (n=2,083)	8.4 (8.3-8.4)	7.9 (7.8-7.9)	0.0001			
Mean BMI, kg/m ² (n=1,730)	27.0 (26.7-27.2)	27.0 (26.7-27.2)	0.3040			
Mean LDL, mmol/L (n=1,243	2.2 (2.2-2.3)	2.1 (2.1-2.2)	0.0001			
Mean TC, mmol/L (n=1,134)	4.1 (4.0-4.2)	3.9 (3.9-4.0)	0.0001			
Mean TG, mmol/L (n=1,134)	1.7 (1.7-1.8)	1.6 (1.6-1.7)	0.0016			
Cost Savings						

- A pilot case-cohort study in 2018 on the clinical and economic outcomes of a MDT approach in DFU management (LEAPP Clinic) demonstrated a significant decrease in mean time from referral to index clinic visit (38.6 to 9.5 days, p < 0.001), increase in outpatient podiatry follow-up (33% to 76%, p < 0.001), decrease in 1-year minor LEA rate (14% to 3%, p=0.007) and decrease in 1year major LEA rate (9% to 3%, p=0.05) [6]
- Simulation of cost avoidance demonstrated an annualised cost avoidance of USD \$1.86 million for patients within the LEAPP cohort and we expect direct healthcare costs savings within DEFINITE to be similar/higher

Problems Encountered

- High defaulter rates: the average defaulter rate from July 2020 to June 2021 for TTSH and KTPH is 17.3% and 14.2% respectively
- To improve patient-carer health literacy with engagement, education and empowerment
- To develop standardized patient education resources
- Manpower resource challenges: shortage of Podiatrists trained in DFU care; hiring of suitable candidates for the role of Diabetic Foot Coordinator
- Continual engagement of clinical staff and senior management to ensure buyin and program endorsement

Strategies to Sustain

- With more than 60 healthcare professionals across disciplines and institutions within DEFINITE Care team, we organise bi-monthly Clinical Review Meetings and quarterly Journal Clubs sessions to review our progress and share evidence-based practices and knowledge respectively
- In collaboration with HSOR and as part of the 3-year program, we will further perform sub-group analysis to enable targeted interventions for risk-stratified population and demonstrate the long-term financial sustainability through health economics analysis
- To foster stronger collaboration with primary care partners (e.g. CN-PCN team, community Nursing, GPs), community partners (e.g. Diabetes Society, NTUC Health, 7 Vision) and other National DM-related programmes (e.g. SiDRP, HALT-CKD, NPSC National DM Collaborative)
- The team will aim to eventually involve patient representatives (patients with healed DFU and patients with major amputation), for a more balanced and patient-centric team

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